A LIGHT to the LONGITUDE :

OR

The Use of an INSTRUMENT

CALLED

The SEAMAN'S DIRECTOR

SPEEDILY

Resolving all *Astronomical* Cases and Questions
Concerning the *SUN*, *MOON*, and *STARS*.

WITH

Several *Propositions* whereby *Sea-men* may find
at what *Meridian* and *Longitude* they are at,
in all Parts of the WORLD.

Published for the Advance of NAVIGATION.

By *Robert Theaker.*

LICENSED, June 28. 1665.

Roger L'Estrange.

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To the READER.

Aving for many years taken diligent notice of the Diurnal Motions of the Heavens, and how the Sun, Moon, and Stars did daily pass, and appear to be South once in 24 hours, at all the respective Meridians in the world. I did apprehend that there might be contrived an Instrument which would readily distinguish to all men at what perticular Meridian and Longitude they were at in all parts : And so did at last after many alterations and examinations complete this Instrument, now called, A Light to the Longitude ; which doth in a plain and facil way speedily Answer all Astronomical Propositions concerning the Sun, Moon, and Stars, only by turning the upper Plain representing the Heavens or Terrestrial Globe, without the knowledge of the doctrine of Spherical Triangles, which many men did never attain to : Also by frequent practice and a little Instruction in using this Instrument, all the Constellations and fixed Stars in the heavens are readily found out and known in all places at any hour of the Night, very helpful to practical Seamen in the Art of Navigation, and being joyned with the true nature and way of the turning this Instrument, I suppose they will speedily find at what particular Meridian they are

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To the Reader.

at, which is indeed true Astronomical, Geographical, and Hydrographical *Longitude*, and is not the measuring of *Distances* betwixt any two *Meridians* by Pendulums, Sand-glasses, Water-glasses, &c. but offereth to find under which of the 360 *Meridians* all Islands, Head-lands, Main-Lands, Cities and Towns are truly Situated and Placed, against which there hath been much opposition endevouring to darken and put out this Light to the Longitude: But there was a person (very well known to most Navigators) which stood in the Gap, and defended it from being quite extinguished, whose further Study and endevors I doubt not but will daily add more and more Light to this matter, until at last practical Sea-men gain the honour, and bring home their undeniable Proof-pieces, and put an end to all Objections; And so for present I leave all my endevours to your favourable Construction, hoping they will prove worthy of your Acceptance, and in time beneficial to all men.

Your Friend

Ro. Theaker.

IF there be any one that desireth to be more fully instructed in the use of this Instrument, they may repair unto Charles Saltonstall Publick Professor and Teacher of the Mathematicks, living neer the Postern-gate on East-Tower-hill, who will satisfie their desires.

The full Description of an Instrument lately In-vented by Robert Theaker *, but now upon his request explained , and the manifold Uses thereof written for the general good, by* Charles Saltonstal *, Professor and Practitioner of the* Mathematick *, neer the* Postern-gate *on* East-Tower-hill.

T H I S Instrument consisteth of two Plains , the lowermost representeth the Terrestrial Globe, and standeth fix'd, and is not to be removed at all , and thereupon is delineated and drawn three distinct hour Circles; the outwardmost Circle is divided into 24 Hours , ending at ♈ *Aries*, and numbred into the East with 1, 2, 3, 4, &c. until the whole Circle be counted round about to 24 hours ending again at ♈ *Aries* where it first began. In this hour Circle is reckoned the right Ascension of the Sun ot fixed Stars, according to time, or in Hours and Minutes; The next, or second hour Circle I call ♈ *Aries hour-Circle* ; because ♈ *Aries* stands there betwixt 24 hours in the outward hour-Circle , and 12 hours in the inward or third hour-Circle , and this hour-Circle is numbred from 12. of the Clock at Noon the Meridian of *London*, into the West, with 1, 2, 3, 4, &c. to 12 of the Clock at Night ; and from thence back again with 1, 2, 3 4, &c. to 12. of the Clock at Noon the Meridian of *London* , where it first began ; now in this hour-Circle is reckoned the time of Sun-Rising or Setting, the hour of any fixed Stars Rising or Setting, and coming to the South,

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as hereafter in the use of this Instrument will more evidently appear; The third hour-Circle beginneth at ♈ *Aries* with 12 of the Clock the beginning and ending of all Longitude in the Equinoctial, where is also placed 360 degrees, and is numbred into the West, with 1, 2, 3, 4, &c. to 12 of the Clock, and from thence back again with 1, 2, 3, 4, &c. to 12 of the Clock where it first began, ♈ *Aries*; In this Circle is reckoned the difference of time, as hereafter will amply appear ; The next and innermost Circle drawn upon this fixed Plain representing the Terrestrial Globe is the Equinoctial beginning and ending at ♈ *Aries* with 360 degrees, Numbred into the East with 10, 20, 30, &c. until it be counted round about, and then concludeth again with 360 degrees where it first began, the beginning and ending of all Longitude upon the Earth; Then upon this lower fixed plain representing the Terrestial Globe, there are drawn at every tenth degree from the Equinoctial, straight Lines, all meeting in the Centre, which is here in this Projection counted the Pole of the World; then from that Centre or Pole, at every ten degrees Latitude or Breadth from the Equinoctial, there is drawn a Concentrick Circle, which are numbred by Tens from the Equinoctial in this manner, 10, 20, 30, 40, &c. concluding with 90 degrees in the Centre, or Pole, all graduated upon a moving Meridian turning about in the Centre, which is here counted the Pole of the World, by which means the Latitude of all places upon the Terrestial Globe are readily discovered and made known ; Then there are also two small Protractors represented containing the 32 points of the Compass upon this fixed Plain, which may be made of Brass, Horn, or Pastboard at pleasure, by which means all Courses and Bearings betwixt place and place according to the Terrestrial Globe, thus *projected in Plano*, wherein you may readily find the Latitude, Longitude, Course, and Distance, betwixt any two places howsoever situated upon the Terrestrial Globe : And by the Application of the upper Moving or Turning Plain representing the Celestial Globe, many excellent Matters, Operations and Conclusions in *Astronomy* are readily performed, and plainly demonstrated according to the Motions of the Heavens, as will be hereafter amply manifested.

The Description of the Upper Moving-Sphere or Plain, representing the Celestial Globe.

IN this Upper Moving Plain or Sphere, upon the outward edg there is drawn the Circle of Months numbred by tens, contrary to the Diurnal Motion, placing alwayes the tenth day of *March* at ♈ *Aries*, by which means you may there find any day of the year you desire, and so know the exact time of the Sun or Stars Rising, Setting, and coming to the South, as hereafter will amply appear: The next and innermost Circle described upon that uppermost Moving Plain, or Sphere, is the Equinoctial Circle Numbred by 10 degrees, 20, 30, 40, &c. into the East, until you count round about to ♈ *Aries* again, and there end and finish with 360 degrees, where you first began, in the same manner as the Equinoctial is numbred and described on the lower fixed Plain; And from this Equinoctial is reckoned the Sun or Stars Declination, upon another moving Meridian called an *Index*, placed and turned about in the Centre of this upper moving-Plain, as hereafter in use will facilly appear; Then upon this upper Moving Sphere or Plain there is described the Ecliptick Circle, being the path-way of the Sun, and is numbred from ♈ *Aries* in the Northern Signs with 10 degrees, 20 degrees, and then 30 degrees, and then beginning again from ♉ with 10 degr. 20 degr. & then 30 degr. and so in the same manner numbring again from ♊ *Gemini* 10 degrees, 20 degrees, and 30 degrees to ♋ *Cancer*; attributing and allowing to each Sign 30 degrees; and so in the same manner are the Southern Signs numbred, beginning from ♎ *Libra* with 10 degrees, 20 degrees, and then 30 degrees; and then beginning again from ♏ *Scorpio*, with 10 degrees, 20 degrees, and then 30 degrees, &c. reckoning still on in the same manner, until you have counted round about and return again to ♈ *Aries*, where you first began; keeping the same order as you did in the Northern Signes, allowing 30 degrees to each Sign; And on this Moving Plain there is also a smaller Circle described representing the Tropicks of ♋ *Cancer* and ♑ *Capricorn* touching the Ecliptick in the first minute of ♋ *Cancer* and ♑ *Capricorn*; *Cancer* shewing that the Sun's greatest Declination North, is 23 degrees 30 Minutes; and ♑
Capricorn.

Capricorn sheweth the Sun's greatest declination South is also 23 degrees and 30 minutes, the Tropicks only shewing the turn-points in the Ecliptick, as the word signifies, declaring and setting bounds to the Sun's greatest Declinations North or South, not to exceed 23 degrees, 30 minutes, but must then turn back again. There is also belonging to this moving Plain, representing the Celestial Globe, a Moving Meridian I call an *Index*, graduated both wayes from the Equinoctial, numbred with 10 degrees, 20, 30, 40, &c. concluding with 90 degrees in the Centre or Pole of the World, and the whole graduated Moving Meridian is exactly in length equal to the Diameter of the Equinoctial described on that upper Moving Plain, and the other parts of this Moving Meridian or *Index*, which are beyond or without the Graduated parts, serveth to cut the Circle of Months, the hour-Circles and Equinoctial described, on the fixed or lower Plain, as the Case shal require. Lastly, there is placed upon this Upper Sphere or Moving Plain, a Turning Horizon in the Centre, being to draw all Pannoles thereupon, and may be fitted for any Latitude required, having two *Indexes* thereunto belonging, the Longer *Index* to be applied for the Rising or Setting of the Sun, when he is in the Northern Signs : or for the Southing, Rising, and Setting of the Northern Stars, and the shorter *Index* is to be applied to the Meridian for the Rising, Setting, and Southing the Southern Stars, or for the Sun when the Sun is in the Southern Signs. These are all the parts of this Instrument described on the lower fixed Plain representing the Terrestrial Globe; as also the Moving Upper Sphere, or Plain, representing the Celestial Globe, which being well understood, and rightly applyed, will perform many excellent things in *Navigation* and *Astronomy*.

Having

*Having the day of the Month known. To find the Sun's
Declination, his place Sign, and Degree in the Ecliptick,
and his right Ascension in Degrees and Minutes or in
Hours and Minutes.*

THese propositions are all readily wrought by this Instrument
by the Circles described on the uppermost plain representing
the Celestial Globe, and by the outwardmost hour-Circle in the
lower plain representing the Terrestrial Globe, between the Equi-
noctial and the Center which is the Pole of the World: first then I
say, turn the uppermost Sphere, being the Celestial Globe, untill
♈ *Aries* there agree with ♈ *Aries* in the lowermost Shere repre-
senting the Terrestrial Globe, then bring the moving Meridian or
Index to the day of the Moneth wherein you desire to know any of
these several propositions, and you will then find that the distance at
that time in the upper plain betwixt the Equinoctial & the Ecliptick,
reckoned in the moving Meridian or Index, is the Sun's declina-
tion ; and the point or place cut in the Ecliptick at the same time
by the same moving Meridian or Index, sheweth the Sign,
Degree, and Minute that the Sun is in at that time. And the
Degree and Minute then cut in the Equinoctial, by the same move-
ing Meridian or Index, sheweth the Sun's right Ascension in Degrees
and Minutes, and then in the outwardmost Hour-Circle on the
lower plain the same moving Meridian or Index sheweth the
Sun's right Ascension in time or Hours and Minutes. So the 23d day
of *February* you will find by this Instrument that the Sun hath
6 Degrees South declination, his place and Sign in the Ecliptick
15 Degrees of ♓ *Pisces* one of the Southern Signs, his right Ascen-
sion in Degrees 346 Degrees, whose complement to a whole Circle
is 14 Degrees, the distance from ♈ *Aries* the next Equinoctial
point, and the time of the Sun's right Ascension is in Hours and
Minutes 23—4, and the complement from ♈ *Aries* in time is 56
Minutes.

So in the same manner, the 20th day of *Aprill*, if you desire to
know the Sun's Declination, his place, Sign, and Degree in the
Ecliptick, his right Ascension, in Degrees and Minutes, as also in
Hours and Minutes ; fix this Instrument in all respects as before,

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making ♈ *Aries* in the upper plain and ♈ *Aries* in the lower plain to ſtand right againſt each other, and then bring the moving Meridian or Index to the 20th day of *Aprill*, and you will then find the Suns declination is 15 degrees North, his place in the Ecliptick 10—8 Degrees eight Minuts of ♉ *Taurus*, his right Aſcenſion in Degrees from *Aries*; the next Equinoctial point is 38 degrees, which in time is 2—32 Hours thirty two Minutes, as appeareth in the outwardmoſt hour-Circle in the lower plain, where the moving Meridian cutteth.

So the 31 day of *May* you will find the Sun's declination 23-10 Degrees and ten Minutes North, his place in the Ecliptick 19—50 nineteen Degrees and 50 Minuts of ♊ *Gemini*, his right Aſcenſion 78 Degrees from ♈ which in time is 5—12 Hours and twelve Minutes, as appeareth in the lowermoſt outward hour Circle, and ſo in the ſame manner all ſorts of propoſitions of the like Nature.

Note all theſe five propoſitions: that is to ſay, the Sun's declination, the Sun's place, the Degree and Sign, which the Sun is in every day, the Sun's right Aſcenſion in Degrees, the Sun's right Aſcenſion in Hours, and Minutes, are all anſwered at one operation, only by bringing the moving Meridian or Index to the day of the Moneth, which is an exceeding great diſpatch, and will prove very profitable in Aſtronomical practices.

The Sun's place in the Ecliptick being known, to find the Hour and Minute of the Sun's Riſing or Setting any day of the Year.

THe Sun's place being found by this Inſtrument, as hath been formerly taught; bring the longeſt Index of the Horizontal plain having nothing but the pannage thereon graduated unto 12 a clock in ♈ *Aries* hour-Circle, the ſame Index then cutting 20 Degrees of longitude in the lowermoſt plain, the longitude of the City of *London*, and there keep that Horizontal Index faſt, and then turn the upper moving plain, repreſenting the Celeſtial Globe, untill the place of the Sun in the Ecliptick come exactly to the plain Horizon, at which edg interſecting or touch point

keep

keep the Ecliptick farſt, and then bring the moving Meridian or Index to that interſection, made by the meeting of the Sun in that point in the Horizon, and then at that time in the Eaſt Hemiſphere in ♈ *Aries* hour-Circle, you will find the moving Meridian doth there cut the Hour and Minute of Sun riſing, and in the Weſt Hemiſphere, the other end of the moving Meridian in ♈ *Aries* hour-Circle doth at the ſame time ſhew the Hour and Minute of Sun Setting; alſo at the ſame time the moving Meridian will ſhew the Sun's declination in the moving Meridian and day of the Month in the Circle of daies and Months, whether the Sun be either in any of the Northern Signs or Southern Signs.

So the Sun being in the firſt Minute of ♉ *Taurus*, bring the longeſt Index of the Horizon to 12 Hours and 20 Degrees in the lowermoſt fixed plain, and there keep that Index faſt; then turn about the upper moving Sphere untill the firſt Minute of ♉ *Taurus* in the Ecliptick interſect, touch or joyneth with the edge of the plain Horizon, and there hold all faſt together, and then bring the moveing Meridian or Index to that point or interſection in the Horizon, & one end in ♈ *Aries* hourCircle in the Eaſt Hemiſphere will ſhew the Sun Riſeth then at 5 a clock in the Morning; and the other end at the ſame time in the Weſt Semicircle of the Sphere in ♈ *Aries* hour-Circle will ſhew the Sun then Setteth at 7 a clock in the Afternoon. Note when you would know the time of Sun Riſing, you muſt count the hour from 12 in ♈ *Aries* hour-Circle backwards calling 11 one, 10 two, 9 three 8 four, 7 five, 6 ſix, 5 ſeven &c. or having the hour of Sun Setting if you ſubſtract that from 12, there will reſt the hour of Sun Riſing : ſo if the Sun Riſeth at 5 that ſubſtracted from 12 reſteth 7 a clock for Sun Setting, or if the Sun Setteth at 7 a clock that ſubſtracted from 12 reſteth 5 hours for the time of Sun Riſing. Alſo now at the ſame time that end of the moving Meridian or Index which cuts the Sun's place brought to the Horizon in the Circle of daies and months, will ſhew that it is now the 10th day of *Aprill*, and that the Sun hath now 11 Degrees and 35 minuts North declination accounted in the moving Meridian or Index.

So in the ſame manner the 20 day of *October*, the Sun being then in the 7 Degree of ♏ *Scorpio*, by this Inſtrument, as hath been formerly taught, you will find the Sun Riſeth at 7 a clock 13 minuts

past in the morning and Setteth at 4 a clock 47 minutes past in the Afternoon : and in the Circle of Months the moving Meridian will shew then that it is the 20 day of *October*, and at the same time on the moving Meridian or Index you will see the Sun hath 14 Degrees South declination; and so in the same manner you may find all these several propositions : the Sun being in any Sign and Degree in the Ecliptick, in all which you may facilly perceive, very great expedition and dispatch, which will prove very usefull to all practical Sea-men, and such as have occasion to inquire into these Astronomical cases.

To find any fixed Stars Declination, right Ascension in Degrees and Minutes, or in Hours and Minutes, his place, Sign, and Degree, or Longitude in the Ecliptick, and day of the Month belonging to that Star.

THese propositions are all readily wrought by this Instrument, by the application of the great Circles, described on the uppermost moving Sphere or plain representing the Terrestrial Globe, and by the moving Meridian or Index thereon placed, with the help of the outwardmost hour-Circle placed on the lower fixed plain representing the Terrestrial Globe; for if you turn the upper plain untill ♈ *Aries* in that plain agree or point directly with ♈ *Aries* in the lower fixed plain representing the Terrestrial Globe, and there hold it fast, and then bring the moving Meridian or Index to that Star whereof you desire to know the declination, right Ascension in Degrees or Time, his place and Degree or longitude in the Ecliptick, with the day of the Month belonging to that Star, and there also hold that moving Meridian fast; and you will then find in the moving Meridian that the distance betwixt the Equinoctial and the Star is his declination, the Degrees cut in the Equinoctial his right Ascension in Degrees, and the hour cut by the same moving Meridian or Index at the same time in the outwardmost hour-Circle upon the lowermost fixed plain sheweth his right Ascension in hours and minutes; also at the same time this moving Meridian or Index doth then cut in the Ecliptick the

place,

place, Sign, Degree, and longitude of that Star : and laftly, this movingMeridian doth then fhew in theCircle of months the day of that month belonging to that Star wherein all thefe Aftronomical effects, cafes, and conclufions come to pass.

So if you defire at any time to know the declination, right Afcenfion in Degrees and Time, the place, Sign, Degree, and longitude of the fixed Star called *Orion's* left fhoulder : Firft turn the upper plain untill ♈ *Aries* in that moving plain be right againſt ♈ *Aries* in the lower fixed plain, and there keep them together , then bring the moving Meridian or Index unto the Star called *Orion's* left fhoulder, and there alfo ſtay and hold faſt that moving Meridian, and then you will readily find the diſtance between that Star and the Equinoctial reckoned in the moving Meridian is 6 Degrees, which is his declination, North ; and the fame moving Meridian will then at the fame time cut 77 Degrees in the Equinoctial, which is his right Afcenfion in Degrees, and alſo at the fame time cutteth in the outward hour Circle on the fixed plain 5 hours and 8 minutes, which is his right Afcenfion in time ; and in the Ecliptick the fame moving Meridian at the fame time cutteth 18 of ♊ *Gemini* which is his place or longitude ; and laſtly, the fame Index at the fame time in the Circle of Months sheweth that it is the 29th day of *May*, all which by this Inſtrument is apparently manifeſted at one and the fame time, which is a notable diſpatch, and worthy of obſervation. So again in the fame manner, if you defire to find all thefe Aftronomical propofitions concerning the Star called the *Great Dog*, move as before the upper plain untill ♈ *Aries* there ſtand right againſt ♈ *Aries* in the lower fixed plain, then bring the moving Meridian or Index to the Star called the *Great Dog* , and you find the diſtance betwixt that Star and the Equinoctial reckoned in the moving Merridian, is 16 Degrees 32 minutes, which is his declination South, and at the fame time this moving Meridian in the Equinoctial sheweth his right Afcenfion is 98 Degrees, and in the outward hour-Circle in the fixed plain sheweth 6 hours 32 minutes is the *Great Dog's* right Afcenfion in time, and then laſtly cuts in the Ecliptick 7 Degrees of ♋ *Cancer* which is the *Great Dog's* place or longitude, and in the Circle of Months 17 day 2 minuts of *June* , and fo of all other Stars whatfoever.

To

To find, every day in the Year, when any of the fixed Stars comes to the South.

Irſt, bring the moving Meridian or Index to 12 hours in the lower fixed plain in ♈ *Aries* hour-Circle, then the ſame Index at the ſame time will alſo cut 20 Degrees in the Equinoctial, deſcribed on the lower fixed plain, which is in this projection accounted the longitude of the City of *London*, and there keeping the moving Meridian faſt, turn the upper plain repreſenting the Celeſtial Globe untill the moving Meridian alſo cut the Starr which you deſire to know at what time it comes to be South, and there keep the Star faſt, and then turn the moving Index or Meridian to the day of any Month, and in ♈ *Aries* hour-Circle the ſame moving Meridian will ſhew the hour when that Star cometh to the South.

So the Star called the *Great Dog* being brought to ſtand right againſt 12 hours and 20 Degrees in the lower fixed plain, and there kept faſt, and then if you turn the moving Index or Meridian to the firſt day of *January*, the ſame Index will then ſhew in ♈ *Aries* hour-Circle 11 a clock at night at which hour the Star called the *Great Dog* cometh to the South; and if you then keep the Inſtrument unaltred, and turn the ſame moving Meridian to the firſt day of *November*, the Index then in ♈ *Aries* hour-Circle will ſhew 3 a clock 24 minuts in the morning, which is the time when the *Great Dog* cometh to the South: and on the firſt day of *December* the Index ſheweth 1 a clock 16 minutes in the morning for the hour when the *Great Dog* cometh to the South.

So in the ſame manner, if you would know when the Star called *Orion's left ſhoulder* cometh to the South, that Star brought to 12 hours and 20 Degrees in the lowermoſt fixed plain, the longitude of *London* as before, the moving Meridian brought to the firſt day of *January* will ſhew 9 a clock 37 minuts paſt in the afternoon, and then the Star called *Orion's left ſhoulder* cometh to the South.

To find, every day in the Year, when any of the fixed Stars Riseth or Setteth.

HEre in this case, if it be a Star that hath North declination, bring the longest Index of the moving Horizon, to 12 a clock in ♈ *Aries* hour-Circle, which will then also cut the fixed Equinoctial 20 Degrees, the longitude of the City of *London* according to this projection: but if it be a Star that hath South declination then bring the shortest Index of the moving Horizon, to 12 a clock in ♈ *Aries* hour-Circle and 20 Degrees in the lowerm ost fixed Equinoctial as before, and there keep the Horizontal Index fastand turn the upper moving Sphere, or plain representing the Celestial Globe, untill the Star, the time of whose Rising you desire to know come exactly to touch the Circular edge of the moving Horizon in the East Semicircle of the moving Sphere; or if you desire to know the time of the Stars setting, turn the whole moving Sphere or plain untill the Star come to the Circular edg of the moving Horizon in the West Semicircle of the moving Sphere; I call the East Semicircle that which is conteined betwixt ♈ *Aries* and ♎ *Libra*, the Ecliptick having thereon placed the six Northern Signs *viz.* ♈ *Aries*, ♉ *Taurus*, ♊ *Gemini*, ♋ *Cancer*, ♌ *Leo*, ♍ *Virgo*, and in the Circle of months, *Aprill, May, June, July, August, September*; and the other Semicircle betwixt ♈ *Aries*, and ♎ *Libra* contein the Southern Signs and the Circle of months, *March, February, January December, November*, I call the West Semicircle: and in the East Semicircle I alwaies contein the Sun or Stars Rising, and in the West the Sun or Stars Setting: now the Star thus stated keep all, turn the moving Index or Meridian to the day in the Circle of month wherein you desire to know the time of that Stars Rising or setting, and the same Index at the same time will shew in ♈ *Aries* hour-Circle, the time of that Stars Rising, if the Star touch the Horrizontal edg in the East Semicircle, or in ♈ *Aries* hour-Circle, will shew the time of the Stars Setting if the Star touch the edg of the moveing Horizon in the West Semicircle of the Spheer.

So the Star called the *Great Dog*, if you desire to know the time of

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his Rising the 10 day of *March*, (being the Star's declination is South) bring the shortest *Index* of the moving Horizon to 12 of the Clock in ♈ *Aries* hour Circle, and to 20 degrees in the lower fixed Equinoctial; then keeping that *Index* there fast, turn the whole moving Sphere or Plain until the Star called the *Great Dog* come exactly to the edg of the Horizon in the East Semicircle, and then the moving *Index* or Meridian brought to the 10 day of *March*, will shew in ♈ *Aries* hour-Circle, that the *Great Dog* riseth at 1 of the Clock, 52 minutes in the Afternoon, and sets at a 11 of the Clock and 8 minutes in the Afternoon, when the Star is at the edg of the Moving Horizon, in the West Semicircle.

And after the same manner, if you desire to know when the Star called *Orion's left shoulder* riseth or setteth the 10. day of *March*; now because the Star hath North declination, keep the longest *Index* of the moving Horizon on 12 of the Clock in ♈ *Aries* hour Circle, and 20 degrees in the lower fixed Equinoctial as before, then turn the upper Sphere or moving Plain until the Star, called *Orion's left shoulder*, come to the edg of the Horizon in the East Semicircle, and there keeping all fast, bring the moving Meridian to the 10 day of *March*, and the same *Index* in *Aries* hour Circle will shew that *Orion's left shoulder* riseth at 10 of the Clock and 40 minutes in the morning, and if the same Star be brought to the edg of the moving Horizon, in the West Semicircle, and then the moving Meridian brought to the 10. of *March*, the same *Index* will shew in ♈ *Aries* hour-Circle that the *Orion's left shoulder* sets at 11 of the Clock and 40 minutes in the Afternoon: and so of all others.

To find the Sun's Rising or Setting the same way as you find the Stars Rising or Setting.

Formerly it hath been shewed, that when the *Index* of the Horizon was placed upon the Meridian of *London*, at 12 hours and 20 degrees Longitude in the lower fixed Plain, and there kept fast, then the place of the Sun brought to the Horizon, and the

moving

moving Meridian to the day of the Month defired, one end of that *Index* in the Eaſt Semicircle would then ſhew the time of Sun Riſing, and the other the time of Sun Setting, but the Riſing and Setting of the fixed Stars could not be ſo found; for after the *Index* of the Horizon was kept at the Meridian and Longitude of *London*, then the ſame Star was brought firſt to touch the Eaſt part of the Horizon, and then according to the day propoſed, the moving Meridian did in ♈ *Aries* hour-Circle ſhew the time of that Star's Riſing, and then the ſame Star brought again to touch the Weſt part of the Horizon, and the moving Meridian turned to the ſame day in ♈ *Aries* hour-Circle ſhewed the time of that Star's Setting; So in the ſame manner, if you pleaſe, you may imploy the place of the Sun to the Eaſt part of the Horizon for his Riſing, and the Weſt part for his Setting; and the moving Meridian brought to the propoſed day, when the Sun is at the Eaſt part of the Horizon, will in ♈ *Aries* hour-Circle ſhew the time of Sun Riſing; and on the ſame day, when the Sun cometh to the Weſt part of the Horizon, the ſame moving Meridian in ♈ *Aries* hour-Circle will ſhew the time of Sun Setting: Provided alwayes if the Sun be in any of the Northern Signs, and ſo hath North declination, then you muſt bring the longeſt *Index* of the Horizon to 12 hours and 20 degrees in the fixed Plain, the Longitude of *London*, and then proceed as before hath been taught: But if the Sun be in the Southern Signs, and ſo hath South declination, then bring the ſhorteſt *Index* of the Horizon to 12 Hours and 20 degrees, in the lower fixed Plain, the Meridian and Longitude of *London*, and then proceed to find the Riſing and Setting of the Sun upon the day propoſed.

So the 20 day of *April*, the Sun's place being 10 degrees 12 Minutes of ♉ *Taurus*; now becauſe ♉ *Taurus* is one of the Northern Signs, and ſo the Sun hath North declination, bring the longeſt *Index* of the moving Horizon to 12 hours 20 degrees in the lower fixed Plain, the Meridian of *London*, then bring the Sun's place in the Ecliptick firſt to the Eaſt part of the Horizon, and ſo keep all faſt, and then turn the moving Meridian to the 20 day of *April*, and it will then ſhew in ♈ *Aries* hour-Circle that the Sun Riſeth at 4 of the Clock 41 Minutes paſt in the morning, & Setteth at 7 of the Clock 41 minutes paſt in the Afternoon; Or if

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you defire to know the 20 day of *October*, at what time the Sun Rifeth or Setteth. Now again, becaufe the Sun's place is 7 degrees of in *Scorpio*, one of the Southern Signs, and fo hath South declination, bring the fhorteft *Index* of the moving Horizon to 12 of the Clock and 20 degrees in the lower fixed Plain, and there keep it faft; and then turn the upper moving Plain, until the Sun's place 7 degrees of in *Scorpio* come to the Eaft part of the Horizon, and then the moving *Index* brought to the 20 day of *October*, will fhew the Sun then Rifeth at 7 of the Clock 13 minutes paft in the morning, and fets at 4 of the Clock 47 minutes paft in the Afternoon; which is a much better way then to count one end of the Morning *Index* to cut the Hour of Sun fetting, and the other end counted back from 12 in *Aries* hour Circle for the time of Sun Rifing, as hath been formerly taught; Alfo by this means the whole moving upper Plain reprefenting the celeftial Globe, being turned about in this Diurnal Motion upon any day required, will fhew the time of the Sun's Rifing or Setting, and all the Stars Rifing, Setting, and coming to the South in order, from whence in *Aftronomy*, many beneficial conclufions may be readily drawn; Seeing this Inftrument is fo exact, and maketh fuch extraordinary difpatch anfwering many varieties all at once, which by proportion and the doctrine of Spherical Triangles, will require longer time, notwithftanding the help of the Logarithmes and Natural Signs provided in our dayes.

To find the Sun's Altitude every day of the year when he comes to the Meridian.

THIS propofition is very ufeful for all Seamen readily to fet the fhadow vein in obfervation at Sea to find the Latitude; Firft then, if you turn the moving Meridian and fhorter *Index* of the Horizon both together, to ♈ *Aries* in the moving Plain, the edge of the Horizon will then cut the moving Meridian in 38 degrees and 30 minutes, the height of the Sun upon the Meridian the 10 day of *March* in the Latitude of 51 degrees and 30 minutes, and is alfo the height of the Equinoctial in that Latitude for ever;
Therefore

Therefore at any time, if you add the Sun's declination when it is North, or substract it when it is South from 38 degrees and 30 minutes, the height of the Equinoctial, it will shew the height of the Sun that day upon his Meridian; so the 20 day of *April* the Suns Declination is 15 degrees North, which added to the 38 degrees 30 minutes, sheweth the Altitude of the Sun that day upon the Meridian is 53 degrees 30 minutes; and the 18 of *October* the Sun hath 13 degrees 30 minutes South declination, which substracted from 38 degrees 30 minutes, resteth 25 degreet, which is the height of the Sun that day upon his Meridian here in the North Latitude of 51 degrees 30 minutes; and so of all others.

To find every day how many Degrees the Sun or Stars dippeth or goeth under the Horizon at Midnight; Also to find the Amplitude of the Sun or Stars every day in the year at their Rising or Setting.

TO find the Sun's Amplitude at his rising or setting by this Instrument; there must also be provided a streight Ruler, to be employed as occasion shall require: First then, when you desire to know the Sun's Amplitude, you must grant the Diameter betwixt ♈ *Aries* and ♎ *Libra* to represent the prime vertical Circle, or Circle of the East and West, and the Quadrant from ♈ *Aries* to 90 degrees, reckoned in the Equinoctial, the Quadrant of Latitudes and the Diameter, betwixt 90 degrees, and 270 degrees, the Horizon Circle; then having the Latitude of any place, and declination of the Sun, bring the moving Meridian to the Latitude, and there keep it fast, then with a pair of Compasses take the declination out of the Equinoctial being one of the great Circles, and joyn it to the point of Latitude, in the Quadrant of Latitudes towards ♈ *Aries*, and then lay a streight Ruler from that point parallel to the moving Meridian, which is held fast at the point of Latitude, and then observe where the Ruler cuts or crosseth the Diameter now representing the Horizon; and then also observe under the Horizon where that streight Ruler cutteth the Equinoctial, and so many degrees doth the Sun or Star dip or go

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under the Horizon or Midnight; then from the fame point in the Horizon, turn or lay the ftreight Ruler parallel to the prime vertical, and then in the Equinoctial, being one of the great Circles, it will cut the true Amplitude of the Sun or Stars, which is alwayes the diftance contained betwixt ♈ *Aries* and that point fo cut.

So in the North Latitude of 51 degrees 30 minutes, the greateft Declination of the Sun being 23 degrees, 30 minutes, if you bring the moving *Index* to 51 degrees 30 minutes in the Quadrant of Latitude, and thereunto joyn the Declination 23 degrees and 30 minutes, and then from that point lay a ftreight Ruler parallel to the moving Meridian or *Index*, it will cut under the Horizon in the Equinoctial 15 degrees, and fo much goeth the Sun then under the Horizon at Midnight; alfo at the fame time note the place or point cut in the Horizon by the fame ftreight Ruler, and then turn or lay the Ruler from that point in the Horizon parallel to the *prime vertical*, and where it cutteth the Equinoctial, the diftance betwixt ♈ *Aries* and that point is the Amplitude, which here at this time appeareth to be 39 degrees and 50 minutes, being the greateft Amplitude the Sun can poffibly have here at *London* in the North Latitude of 51 degrees 30 minutes; And fo in the fame manner you may find the Amplitude of any of the fixed Stars at their rifing or fetting.

Note, If the Sun hath North declination, it is called North Amplitude; and if it hath South declination, it is called South Amplitude, and the greater Latitude the greater Amplitude; and fo of the fixed Stars.

Note alfo, Until the Sun be 18 degrees under the Horizon it is the *Crepufculum* or Twilight; therefore here at *London* when the Sun hath 23 degrees 30 minutes North declination, the Sun dippeth but 15 degrees under the Horizon; Therefore here at *London* at that time, it is not perfect Night at all, but the Twilight continueth.

To find at all Altines when the North Star is directly South above the Pole, or North under the Pole.

TO know at what hour, every Day and Night, the North Star is directly North or South, above or under the Pole; bring the moving Meridian to 12 of the Clock in ♈ *Aries* hour-Circle and 20 degrees, the Longitude of *London*, then turn the upper Plain, until the Star called *Aliot*, being a Star in the *Great Bear's Rumpe*, or the hindmost of the 3 in *Charles his Waine*, unto that *Index* on the North or Southside, and then if that Star be on the South side, the North Star is then 2 degrees 30 minutes under the Pole, and if *Aliot* be on the Northside, the North Star is then 2 degrees 30 minutes above the Pole.

So the 22 day of *March*, *Aliot* is South at 12 of the Clock at Night, and so the North Star is then 2 degrees 30 minutes under the Pole; and the 4 day of *February*, *Aliot* is South at 5 of the Clock in the morning, and so the North Star is then also 2 degrees 30 minutes under the Pole: And the 9 day of *September*, *Aliot* is North at 12 of the Clock at Night, and the North Star is then 2 degrees 30 minutes above the Pole; And the 25 day of *October*, *Aliot* is North at 9 of the Clock at Night, and then the North Star is 2 degrees 30 minutes above the Pole.

To Draw the Parallels of the Sun or Stars Declinations, and thereby to know when they Rise or Set, or whether they Rise or Set at all.

TO draw the parallels of Declination; First, set one Foot of the Compasses in the Pole or Centre of the moving Meridian, and then extend the other foot to 5 degrees, 10, 15, 20, 25, 30, &c. in the same moving Meridian, according as the Declination may require; then with the same extent so taken out of the moving Meridian, set one foot in the Centre of the moving Horizon, and from the Diameter sweep an arch of a Circle both wayes to cut

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the outward edg of that plain Horizon, with points or Crossings in the edg of the Horizon, are the direct places where those Stars come unto at their rising or setting; *Note*, if any Star here in the Latitude of 51 degrees 30 minutes, hath his Declination North equal or more than the Complement of the Latitude, that Star (I say) sets not at all, for then the Compasses in the plain Horizon will sweep an Arch of a Circle within the plain Horizon, and will not reach the outward edg, therefore that Star sets not at all; And so if any Star hath South declination equal or greater than the Complement of the Latitude, that Star riseth not at all in our Horizon, and so of all others.

To find, every Day in the year, at what time any of the Planets cometh to the South.

First, bring the moving Meridian to 12 of the Clock and 20 degrees, the Longitude of *London*, and there keep it fast, and then find the Sign and Degree that the Planet is in at that time, and then turn the whole upper Plain until that Sign and degree come to the moving Meridian placed at 12 of the Clock 20 degrees, and there keep them both fast together, and then look in the Circle of Months for the Day you desire to know the time of that Planets coming to the South, and right against that day in ♈ *Aries* hour-Circle, you will see at what of the Clock that Planet comes to the South.

So ♄ *Saturn's* place or Longitude in the Ecliptick the 15 day of *March*, being 8 degrees 56 minutes of ♑ *Capricorn*, if you turn the whole upper moving Sphere until that Sign and degree in the Ecliptick come to the Meridian placed at 12 of the Clock 20 degrees, and there hold them both fast together, and then right against the 15 day ♈ *Aries* hour-Circle, it will appear that ♄ *Saturn* cometh to the South at 6 of the Clock 20 minutes in the morning; and ♃ *Jupiter's* place or Longitude in the Ecliptick the 15 day of *March*, being 14 degrees 3 minutes, in ♒ *Aquarius* cometh to the South at 8 of the Clock 46 Minutes past in the Morning; and the same day *Mars* being in 3 degrees 4 minutes of

of ♓ *Pisces*, cometh to the South at 10 of the Clock in the morn-
ing; and ♀ *Venus* the same day being in 18 degrees 50 minutes of
♉ *Taurus*, cometh to the South at 2 of the Clock 46 minutes in
the Afternoon; and ☿ *Mercury* being then in 8 degrees 46 minutes
of ♒ *Aquarius*, cometh to the South at 8 of the Clock 46 minutes
past in the Morning; and the same day ☽ *Luna* being in 19 de-
grees 22 minutes of ♋ *Cancer*, cometh to the South at 7 of the
Clock 22 minutes past in the Afternoon, allowing 2 minutes in
the Ecliptick for each hour to be added to the place of the Moon,
so here was added 14 minutes; *Note*, if the day whereon you
desire to know when the Star cometh to the South be in the East
Semicircle, they are Morning hours; or if they be in the West
Semicircle, they are Afternoon hours.

To find the true Distance of the Moon's Motion from the Sun.

Frst, by the *Ephemerides* find the Moon's place in the Ecliptick,
then bring the moving Meridian to 12 hours and 20 degrees,
the Longitude of *London*, and then bring the Moon's place in the
Ecliptick also to that Meridian; and there hold them both fast to-
gether, and then in the Circle of Months find the day you desire
to know, at what hour the Moon cometh to the Meridian, and
right against that day you will find the hour of the Moon's then
coming to the South.

So the 17 day of *March*, the Moon being in 18 degrees of
♌ *Leo*, being the moving Meridian to 12 hours and 20 degrees,
the Meridian and Longitude of *London*, then turn the whole upper
Sphere until the Moon's place in the Ecliptick also come to that
Meridian, and there keep them both fast together, and then in
the Circle of Months you will find right against the 17 day of
March 9 hours 13 minutes in the Afternoon, which is the time of
the Moon's coming to the South that day, always in work remem-
bring when you have found 9 hours to allow two Minutes for each
hour, which here is 18 Minutes, which 18 minutes in the Eclip-
tick, at the Rate of 4 minutes for a degree, is 4 degrees ½, and that
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joyned to 18 degrees of ♌ *Leo* the Moon's place maketh 22¾ degrees, which is the true place that the Moon is then in; which brought to the Index placed at 12 hours and 20 degrees as before, and there kept fall right against the 17 day of *March* will appear 9 of the Clock 13 minuts past in the afternoon, which is now the direct true time of the Moon's coming to the South.

Note, On the lower fixed plain in this Instrument, are placed 3 hour-Circles, the outwardmost with 24 hours at ♈ *Aries* is to measure the right Ascension in time; the middle hour-Circle, which I call ♈ *Aries* hour-Circle beginning at 12 a Clock and 20 degrees longitude, is proper for the Meridian of *London*, to measure the hour of the day or night; the third, next the Equinoctial, is to measure time from the general or first Astronomical Meridian according to the distance betwixt the Sun or Stars.

To find the longitude, by knowin gwhen any of the fixed Stars cometh to the South.

First, you must observe, that by this projection in the lower fixed plain representing the Terrestrial Globe, at one single certain point take in the Equinoctial, there is set and placed 360 degrees with 12 of the Clock at noon in the next hour-Circle, and ♈ *Aries* in the second hour-Circle, and 24 hours in the outward hour-Circle, and this Meridian thus stated is the first Meridian of the World, and declareth the beginning and ending of all longitude; which formerly by Geographers hath been placed at several parts of the World, some assigning it to pass through St. *Michaels* Island, one of the *Azores*, others will have it to pass through *Tenaref* one of the *Canary* Islands, and some again will have it pass by or through, the Westermost parts of *Africa*; all as yet grounding themselves, from courses, distances, departures, differences of latituds and longituds, found by expert skilful practical Navigators according to their Sea observations and reckonings; for I suppose there have been as yet but few Eclipses observed to contradict the expert Navigators indeavours, who indeed deserve the honour and thanks for the originals which built that demonstrative Figure and Type

called

called the Terrestrial Globe, and I suppose will in the future gain
the like honour in this great matter, by practical proof confirming
a true Meridian and Longitude properly and peculiarly belonging
to each particular part and place upon the Terrestrial Globe, being
the most competent Judges grounding their knowledg upon their
great Attempts and remote Discoveries, which others, not versed
in those things, must come far short off. Now Astronomically we
say 360 degrees must be accounted for the beginning and ending
of all Longitude, but we cannot place that Meridian upon the earth
at pleasure, for that is absurd and improper; but Astronomically, by
knowing the time of any of the fixed Stars coming to the South,
and the place or Longitude of the Sun in the Ecliptick that day, the
distance then indeed, betwixt the Sun and Star reckoned in the Equi-
noctial, sheweth both their respective right Ascensions and also the
Longitude in degrees or time conteined betwixt them, by which
means this Instrument will readily shew the true Meridian and
Longitude in all places upon the Terrestrial Globe, provided it be
granted, that at every minute of Time in one place or other, the
Sun and Stars are alwaies Rising, Setting, and coming to the Me-
ridian (which is not to be denied) then I say, each particular Me-
ridian and Longitude, upon the Terrestrial Globe, may undoubtedly
be cleerly discovered: For if it were inquired at what Meridian
and Longitude the City of *London* was truly seated, if we should
search the Terrestrial Globes they would shew us several Longituds,
according to the several places, where they appointed the first
Meridian to begin and end all Longitude, and so in effect will shew
us just nothing; for indeed there is but one single proper Meridian
belonging to the City of *London*, or any other place whatsoever,
which may as surely be pointed out and shewed which is it in parti-
cular by this Instrument, as any Astronomical Calculator can tell
you the very Day, Hour, & Minut of the Stars coming to the South,
which many will affirm they can infallibly perform, and several
Authors have already drawn out Tables to that purpose, some of
which I can testify are exceeding well, true, and perfectly done
and performed; but I have not observed that any of them, hath
truly stated and discovered the Meridian properly belonging to the
particular Longitude of *London*, or pointed out which or where it is;
I suppose the reason hath been, because they found the Longituds

of

of places upon the earth were varioufly affirmed, and therefore they medled with none of them.

To find exactly the True Meridian and Longitude of the City of London.

First, by this Inftrument to find the true Longitude of *London*, you muft confider the day of what month you will imploy for this fervice, which day I then call the day of the Sun; then alwaies bring the day of the Sun to 360 degrees, the beginning and ending of all Longitude, then take notice of any of the fixed Stars placed upon the upper moving Plain in this Inftrument, and bring the moving Index to cut that Star, and in the outward hour-Circle you will find the hour and minute of that Stars coming to the South, when the day of the Sun ftandeth at 360 degrees in the Equinoctial, which on the fame day of the Sun will fhew one and the fame hour and minute, for the Stars being South in all the particular Longituds of the World; and fo that hour, common to all Longituds, cannot diftinguifh the particular Meridian of any of them, but this Inftrument from that ground will fhew each proper and particular Meridian and Longitude of all places upon the Terreftrial Globe which cannot be removed or altred; for, if you count in the lower hour-Circle placed next the Equinoctial, 1 hour, 2 hours, 3 hours, 4 hours &c. according to the diurnal motion, untill you bring the day of the Sun to fuch an hour as right againft it will ftand the hour and minute in ♈ *Aries* hour-Circle, anfwerable and equal to the hour firft found in the outward Circle conteining 24 hours a Natural day, at which time the day of the Sun was firft brought to 360 degrees in the Equinoctial, and fo the hour of the Star was that day one and the fame in all Longitudes; but now (I fay) if the day of the Sun be turned to fo many hours and minuts in the lower hour-Circle that then againft the fame day of the Sun in ♈ *Aries* hour-Circle there appear the hours and minutes equal to the hours and minutes firft found in the outward Circle of 24 hours, I fay, the Star propofed will then ftand right againft the proper and particular Meridian and Longitude of the place defired, and cannot poffibly
be

be removed or constrained to stand against any other Meridian or Longitude, but that which properly and particularly belongeth to that one single part, point, or place upon the Terrestrial Globe.

Example.

The first of April, I demand how the proper and particular Meridian and Longitude of the City of London may be found and discovered, by this Instrument.

BRing the first day of *April* to 360 degrees, which I now call the day of the Sun, then find on the upper plain or Sphere the fixed Star called the *Lyons Tayl*, and thereon place the moving Meridian or Index, and then in the outward hour-Circle it will shew that Star cometh to the South at 10 a clock 13 minutes in the afternoon, which is the common hour for all Meridians in the World for that day; therefore now turn about the upper moving Plain or Sphere untill the first day of *April* the day of the Sun come to 8 hours 52 minutes in the lowermost hour-Circle, and then right against the same hour and day of the Sun in ♈ *Aries* hour-Circle you will then find 10 a Clock 13 minutes at night equal to the hour first found in the outward hour-Circle, and so the Star called the *Lyons Tayl* will now stand exactly against 20 degrees in the Equinoctial, placed upon the fixed plain at 10 a Clock 13 minutes at night, which is the proper and particular Meridian and Longitude of the City of *London*, which cannot possibly be removed, changed, or altred, and was never truly found or thus stated by any Man before.

So in like manner, if you will the same first day of *April* imploy the fixed Star called *Hidra's Heart*, to find the true Meridian and Longitude of *London*, bring again the first day of *April* the day of the Sun as before to 360 degrees, and then place the moving Meridian upon that Star, and in the outward hour-Circle it will shew 7 a Clock 52 minutes; therefore now turn the day of the Sun to 6 hours 32 minutes in the lowermost hour-Circle, and then right against that in ♈ *Aries* hour-Circle you will find again 7 a Clock

52 minutes, and then you will find *Hidra's Heart*, will ſtand again directly right againſt 20 degrees, the proper Meridian and Longitude of *London* as before at 7 a Clock and 52 minutes.

So in like manner if you will the ſame firſt day of *Aprill* imploy the Star called *Virgin Spik*, bring the day of the Sun to 360 degrees and place the moving Meridian upon the Star, which will then in the outward hour Circle ſhew 11 a Clock 48 minuts, therefore now turn the day of the Sun to 10 hours 28 minuts, and at the ſame time right againſt that, in ♈ *Aries* hour-Circle, you will find 11 a Clock 48 minutes at night, and then the *Virgin Spike* will ſtand right againſt 20 degrees, the true Meridian and Longitude of *London* as before, and ſo in the ſame manner you may imploy any of the fixed Stars which you think convenient, and they will all affirm the true, proper, and particular Meridian and Longitude of *London* is directly 20 degrees, which cannot be removed, altred, or contradicted by any Man; and ſo being at any place or point upon the Terreſtrial Globe, by this Inſtrument, and the ſame Rule, you may find the proper and particular Meridian and Longitude of that place, which cannot be removed, altred, or denied by any one.

To find the true Longitude of the City of London, *at the Sun's Setting.*

Example.

SUppoſe the tenth day of *April* it be required to find the true Longitude of the City of *London* at the ſetting of the Sun; bring the longeſt Meridian of the moving Horizon to 360 degrees the firſt Index of the world, and there keep it faſt, then turn the upper moving Sphere until the place of the Sun, being then the firſt minute of ♉ *Taurus*, come to the edg of the Horizon in the Weſt Semicircle of the Inſtrument; then bring the moving Meridian or *Index* to the place of the Sun, which *Index* will then at the ſame time in the Circle of dayes and months cut or ſhew the 10 day of *April* the day of the Sun; and now the Inſtrument thus ſtated, keep all the *Indexes* and Horizon unaltered, and then turn

the

the whole upper moving Sphere, until that *Index* which cuts the day and place of the Sun come to 360 degrees, the first Meridian, and then the longest *Index* of the Horizon in the outward hour-Circle will cut 4 hours, which is the distance that day betwixt the Sun when he is on the Meridian, and the time of his setting when he is in the Horizon, and so continues at the same distance, for that day, upon all Meridians and Longitudes until the Sun, by the force of *Primum Mobile*, is carried round about the world; Therefore now again turn the whole moving Sphere unaltered according to his Diurnal motion, until the *Index* at the day of the Sun cut in the innermost hour-Circle 5 hours 40 minutes, and then at the same time the same *Index* will also cut in ♈ *Aries* hour-Circle 7 of the Clock in the Afternoon, the time of Sun setting, which was also the first distance cut in the outward hour-Circle; and then the longest *Index* of the Horizon will stay at 20 degrees, the true Meridian and Longitude of the City of *London*, which cannot be removed, altered, or contradicted, and was never before found, known, or truly stated by any man until Now: and by the same Rule and Directions, being in any part of the world, we can as truly and exactly find the proper and particular Meridian and Longitude belonging to that place, as we have now setled and discovered a true, proper, and particular Meridian and Longitude, not to be changed, removed, or altered for the City of *London*, which was never known or found before, confirmed both by the Southing of a Star, and Setting of the Sun.

THE THIRD WAY.

To find the true Longitude of the City of London at the Sun's Rising.

SUppose the same tenth day of *April* it be required to find the true Meridian and Longitude of the City of *London* at the Sun's Rising; bring the longest *Index* of the Horizon to 360 degrees, the first Meridian as before, and there keep it fast; then turn the upper moving Sphere, until the place of the Sun, being now the

first

first minute of ♉ *Taurus*, come to the edg of the Horizon in the East Semicircle of the Instrument; then bring the moving Meridian or *Index* to the place of the Sun, which will then also cut the tenth day of *April*, in the Circle of Months, which is now the day of the Sun; and so the Instrument thus stated, keep all the *Indexes* and Horizon unaltered; and now being it is Sun Rising, turn the whole moving upper Sphere, until the *Index* which cuts the day and place of the Sun to 180 degrees, or 12 of the Clock at night, and then the longest *Index* of the Horizon will shew in the outward hour-Circle 7 hours, which is the distance being upon the first Meridian Now at 180 degrees 12 of the Clock at Night, which is the distance of the Sun that day betwixt the time when he's upon the Meridian, and riseth in the Horizon, round about the world in all respective Meridians and Longitudes; Therefore now turn again the whole moving Sphere, according to his Diurnal Motion, until the *Index* at the day of the Sun in the innermost hour-Circle, cut 3 Hours 40 minutes; and then the same *Index* in ♈ *Aries* hour-Circle, will shew 5 of the Clock the time of Sun Rising, and the longest *Index* of the Horizon at the same time will stay again at 20 degrees as before, the true Meridian and Longitude of the City of *London*, confirmed by three several wayes, and cannot be removed or altered to any other point, which point of Longitude was never found before.

THE FOURTH WAY.

To find the true Longitude of the City of London by the Moon when she cometh to the South.

SUppose the 11 day of *May*, the Moon being then in 2 degrees of ♌ *Leo*, it were required to shew then the true Longitude of the City of *London*; first bring one Index in the Circle of Months to the 11th day of *May* the day of the Sun, then bring another Index to the 25 degrees of ♌ *Leo*, the Moons place that day, and then the distance betwixt those Indexes will appear in the Equinoctial to be 88 degrees, which in time is 5 a Clock 52 minutes;

therefore

therefore now turn the whole moving upper Sphere, keeping the two Indexes unaltred, and bring the Index placed at the day of the Sun to 360 the firſt Meridian and begining and ending of Longitude, and then the Index of the Moon, in the Equinoctial on the fixed Plain, will ſhew 88 degrees which is 5 hours 32 minutes in time: but in regard the Moon for this diſtance of time muſt have 2 minutes allowed for each hour, take with a pair of compaſſes 15 degrees of the fixed Equinoctial, and then ſet one foot in 88 degrees, and turn over the compaſſes untill they come to 360 degrees, and count how many times they are turned over which here will appear to be 6 times, therefore at 2 minutes for an hour, is 12 minutes, which added to 5 hours 52 minuts maketh 6 a Clock 4 minutes agreeing with Mr. *Wings* calculation, within 2 minutes; with 12 minutes add to 88 make 91 degrees, the true diſtance, the Moons Index now ſtanding there. Then the Indexces ſtill unaltred, turn the whole moving Sphere untill the Moons Index cometh to 6 a Clock 6 minutes, which will alſo cut 111 degrees in the Equinoctial, and then the Index of the Sun will then ſtay again at 20 degrees the true Longitude of the City of *London* as before, which cannot be removed, altred or contradicted by any one. And thus hath the true Longitude of *London* been confirmed by four ſeveral waies to be directly 20 degrees and no more, no Man having before now ever diſcovered what it was, and ſo by the ſame Rule, may the true Longitude of any part of the world be ſpeedily found.

ANOTHER WAY.

To find the true Longitude of the City of London by the Moon when ſhe cometh to the South.

SUppoſe the eleventh day of *May*, the Moon being then in 25 degrees of ♌ *Leo*, it were required to find the true Longitude of the City of *London*; First bring the 11th day of *May* now the day of the Sun to 360 degrees the firſt Meridian, and turn the Index to 25 degrees of ♌ *Leo* the Moon's place, that day, and

then

then the diſtance betwixt the Sun and the Moon will appear, in the Equinoctial upon the fixed Plain, to be 88 degrees, and in the outward hour-Circle 5 a Clock 52 minutes; but now in regard the Moon muſt be allowed 2 minutes for each hour to be added to this diſtance take 15 degrees with a pair of Compaſſes out of the Equinoctial and ſet one foot in 88 degrees, and you will find you may turn them over neer ſix times before you come to 360 degrees the firſt Meridian, therefore you muſt allow 12 minutes which is 3 degrees more in the Equinoctial, and the Moons Index muſt now ſtand at 91 degrees in the Equinoctial, and then in the outward hour-Circle will now ſhew 6 a Clock 4 minutes. Therefore now, keeping the Moons Index unaltred, turn the whole moving Sphere, untill the Index of the Moon cut in ♈ *Aries* hour-Circle to 6 a Clock 6 minutes in the morning, and then the 11th day of *May* the day of the Sun will ſtand right againſt 20 degrees in the Equinoctial, again the true Longitude of the City of *London*, as before, which cannot be altred or contradicted by any one And thus we have ſtated the true Longitude of *London* four ſeveral wayes to be directly 20 degrees and no more; which was not known or diſcovered before this time by any Man.

1. Note, the outward hour-Circle alwaies ſheweth the Suns diſtance from the Star, from the Horizon, or from the Moon in hours and minutes, and the Equinoctial ſheweth the diſtance in degrees.

2. And the Innermoſt hour-Circle ſheweth how many hours and minutes you may turn the day of the Sun or the place of the Moon.

3. And ♈ *Aries* hour-Circle in the middle alwaies in his own accompt ſheweth the ſame hour with the outward hour-Circle, and ſo determineth the hour of the day proper for that Latitude and Longitude which you are at.

Two

*Two several Questions by finding the Moon South to know
what Meridian you are at.*

The first Question.

THe 10th day of *June* 1665 three Men being at Sea, the first
Man had the Moon South at 6 hours 18 minutes; the second
Man, at 6 hours 29 minutes; and the third Man had the Moon South
at 6 hours 32 minutes. I demand what Meridian and Longitude
each of those Men were then at?

Example.

FIrst, the 10th day of *June*, you may then readily find that the Sun
is then in 29 degrees of ♊ *Gemini* at 20 degrees the Meri-
dian of *London*, and the Moon at that time in 3 degrees 50 minutes
of ♎ *Libra*; therefore now set one Index to the 10th day of *June*
the day of the Sun, and the same Index in the Ecliptick will then
cut 29 degrees of ♊ *Gemini*, the place of the Sun: then lay the other
Index on 3 degrees 50 minutes of ♎ *Libra*, the place of the Moon,
and with the Indexes unaltred turn the upper Sphere untill the
Index of the Sun cut 20 degrees the Meridian of *London*, and the
distance betwixt the two Indexes in the Equinoctial will be 94½
degrees which is 6 hours 18 minutes, the first Man's hour of having
the Moon South: but the Index of the Moon then in the Equinoctial
will also cut 115 degrees, the first Man's Meridian and Longitude
that he was at.

The second Man having the Moon South at 6 hours 29 minuts.

THE Indexes remaining as before turn the upper Sphere untill
the Index of the Moon come to 20 degrees the Longitude of
London; but now in regard there must be allowed 2 minutes for an
hour for the Moons depression, which is 12 minutes, therefore turn

E   back

back the Index of the Moon 3 degrees, and then turn again the moving upper Sphere untill the Index of the Moon cut 20 degrees, the Longitude of *London*; and the Index of the Sun will then cut 6 hours 29 minutes: so the second Man had the Moon South at 20 degrees the Meridian of *London*.

The third Man having the Moon South at 6 hours 32 minutes.

THE Indexes not altred from the last proposition, turn the upper Sphere untill the Index of the Moon come to 320 degrees, but now having 3 hours difference, allowing 2 minutes for an hour, turn back the Index of the Moon $1\frac{1}{2}$ degree, and then turn again the upper Sphere untill the Index of the Moon cut 320 degrees, and then the Index of the Sun will cut 6 hours 32 minutes: so the third Man had the Moon South at the Meridian and Longitude of 320 degrees.

The Second Question.

THe 17th day of *June* 1665 fiveMen being at Sea, the Moon then at the full at 10 a Clock 24 minuts past in the morning, the Sun in the 6 degree of ♋ *Cancer* and the Moon in the 6 degree of ♑ *Capricorn* South at 12 a Clock, at 224 degrees the first Man's Meridian and Longitude; but the Second Man hath the Moon South at 12 minutes after 12 a Clock; the third Man 24 minutes after 12; the fourth Man 28 minutes after 12; and the fifth Man 34 minutes after 12 a Clock. I demand, what Meridian and Longitude each of these particular Men were then at?

Example.

FIrst, lay the Index one end on the 17th day of *June* which will then also cut 6 degrees of ♋ *Cancer* the Suns place, and the other end will then cut 6 degrees of ♑ *Capricorn* the Moons place, then move the upper Sphere untill the Suns end of the Index cut 10

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To

THE CONTENTS.

The

To the KING's most excellent Majesty.

Dread Soveraign,

THese following endevours having been brought first of all before Your Sacred Majesty, who did not then despise the day of small things, but out of Your Princely Favour granted Access, and had the patience to hear the Reasons and Objections; Your Heroick Breast being truly inspired and perswaded, that the greatest Mysteries and Matters in the world, were first made known and discovered by plain men, and hid from the Learned; and so to this day the greatest pretended natural knowledges are still over-ruled by practical Proof-pieces; upon which considerations Your Majesties faithful Subjects *Robert Theaker* and *Charles Saltonstall*, after much expences of money and time, are now endevouring to enable all practical Sea-men, with the full knowledg of this Instrument; and in regard *Charles Saltonstall* hath made several long Voyages and

Discoveries,

The Epistle Dedicatory.

Discoveries, instructed and brought up a considerable number of expert Navigators, (many of them being now in your Majesties Service) it is hoped in time he will also enable them with this knowledg, that their Proof-pieces may give an end to all Objections: In which hope for the present I humbly lay all down at Your Majesties Feet, beseeching a favourable acceptance of this Mite, which may prove more worth than the offerings of abundance. And so in all obedience I submit my self to Your Majesties Princely good will and pleasure, desiring the great God of Heaven and Earth to grant Your Majesty a long, prosperous, and happy Reign.

Your MAJESTIES

most humble and obedient

Subject and Servant,

Robert Theaker.

a Clock 24 minutes paſt in the morning, the time of full Moon, and the Moon's end will then cut 224 degrees in the Equinoctial, which is the firſt Man's Longitude at 12 a Clock ; then allowing 2 minutes for each 15 degrees, or one hour of time for the Moon's depreſſion, you will then firſt find that betwixt 224 degrees and 134 degrees is contained 90 degrees, which is 6 hours of time ; now allowing 2 minutes for each hours depreſſion, in all 12 minutes, which is 3 degrees, turn the upper Sphere, the Index unaltred, untill the Moons end come to 134 degrees then 3 degrees allowed for depreſſion maketh exactly 12 a Clock 12 minutes paſt : So the ſecond Man's Longitude muſt be 134 degrees at that time and place.   The third Man having the Moon South 24 minutes after 12 a Clock, allowing 2 minutes depreſſion for each hour, it appeareth that his Meridian and Longitude, when he hath the Moon South, muſt be 44 degrees : becauſe the diſtance betwixt 44 degrees and 224 degrees in the Equinoctial is 180 degrees, or 12 hours, and then 24 minutes which is 6 degrees allowed for depreſſion maketh 24 minutes after 12 a Clock : ſo the third Man muſt have the Moon South at the Meridian and Longitude of 44 degrees. The fourth Man had the Moon South at 20 degrees 28 minutes after 12 a Clock, becauſe the diſtance betwixt 20 degrees and 224 degrees in the Equinoctial is 204 degrees or 13 hours 9 minutes : therefore allowing 2 minutes depreſſion for an hour maketh 28 minutes after 12 a Clock : ſo the fourth Man had the Moon South at 20 degrees the Meridian and Longitude of *London*. The fifth Man had the Moon South at 334 degrees 34 minutes after 12 a Clock, becauſe the diſtance according to the Diurnal motion betwixt 334 degrees and 224 degrees is 250 degrees or 17 hours, allowing 2 minutes depreſſion for an hour, maketh 34 minutes : ſo the fifth Man had the Moon South at 334 degrees 34 minutes after 12 a Clock ; which is all that was required.

The Rule and reaſon for turning the upper Shere is from 360 degrees.

THE rule is to ſee how many hours and minutes the Sun can be turned from the firſt point of ♈ *Aries*, before the Star can come to be South: and the reaſon is becauſe the Star cannot be South but at one time at one Meridian.   *To*

To cut the Horizons for all Latituds.

UPon a peice of pastboard draw two lines Squarewise, that is perpendicular to each other, and let the longest line be the diameter of the upper Sphere, and the shorter the perpendicular, the Latitude from the Center of the Index, by which means, from the Center where the two lines cross each other there is got or found 3 points; now find the Center to those 3 points, and strike an arch, and cut out by that arch the Horizon required.

THE END.

Errata.

PAg. 6. l. 28. for *pannage* read *parallels*, p. 8. l. 17. for *Terrestrial* r. *Celestial*, p. 11. l. 26. for *contein* r. *count*, p. 17. l. 1. for *all Altines* r. *all Times*; p. 24. l. 27. for *first Index* r. *first Meridian*.